

## DEVELOPMENT OF WATER REPELLANT FABRICS FOR SPORTSWEAR COMBINING WITH CHEMICAL AND MEMBRANE

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### ABSTRACT

In recent years, several technologies have been developed for high functional fabrics. Since these fabrics support active sportswear with importance placed on high functions as well as comfort [1]. In this project; water repellent, breathable, high performance weft knitted fabrics will be developed by combining water repellent and water proof applications.

**Key Words:** water repellent, water proof, membrane, sportswear garment

### 1. INTRODUCTION

Expectations from textile materials increase in recent years. Easy care properties such as water, oil and soil-repellent properties come to the forefront.

In the 1990s, having very good water repellent properties that plant leaves of micro structures were analyzed. Then being hydrophobic property was explained [2]. Since that time, opportunity with the increase of opportunities in chemical technology, synthetic hydrophobic surfaces have been developed and applied.

Having effectively intramolecular forces such as polarity and hydrogen bonding provide strength, heat resistance and dry cleaning resistance to the fabric. Also, these forces cause of the outer garments putting up low resistance against snow and rain and fibers easy wetting. This problem has prevented how water repellent chemicals have applied to fabrics. Water repellent compounds cover the outer surface of fabric with hydrophobic groups. These hydrophobic groups form a low energy surface on fabric surface and repulse water molecules [3].

The basis of water repellency process; very thin hydrophobic layer is formed on fibers. Water repellent fabric protects within limits against rain. However, during long and heavy rain, water enter the pores of fabric surface.

Also, water repellent surface allows water vapour passing. This situation provides the clothing comfort.

For water repellent finishing;

1. Resin
2. Fatty acid + Chrome chloride complex
3. Paraffin and wax emulsions
4. Organic Silicium Compounds (Silicones)
5. Fluorocarbons can be used.[4]

## Fluorocarbons

"Fluorocarbon" is general name for most of organic fluorine compounds. They are synthetic compounds that contain carbon and fluorine [4].

Nowadays, generally, perfluoroalkyl and fluorocarbon compounds have used for water, oil and soil repellent performance in textile industry [4].

Fluorocarbons have provided advantages to textile materials into the following:

- textile material have protected against water and stain
- it is resistant to washing and dry cleaning
- due to forming a film layer on textile surface, original colors have protected
- due to air permeability, allows breathability

Today's rising living standards and changing expectations from the garments make comfort features (water resistance, water vapor permeability, air permeability etc.) an important parameter and also they provide wide using areas for laminated fabrics [5].

A waterproof fabric is one in which the pores, the open spaces between the warp and filling yarns and between the fibers, are filled with appropriate substances, resulting in a fabric having a continuous surface and a very low air permeability. A water-repellent fabric is one in which the fibers are usually coated with a "hydrophobic" type of compound, and the pores are not filled in the course of the treatment [6].

**Table 1.** Comparison of Water Repellent and Waterproof Treatments

	<b>Waterproof</b>	<b>Water-repellent</b>
<b>Pores</b>	Filled	Unfilled
<b>Water-vapor permeability</b>	Very small	Small or large
<b>Air permeability</b>	Small	Usually large
<b>Chief characteristic</b>	Extremely resistant to passage of water even under a hydrostatic head.	Resistant to wetting by rain drops and to the spreading of water over the textile surface, but permits the passage of water under a hydrostatic head.

Ozen et al. (2012), in their project they tried to develop water proof breathable fabric. For this purpose, plain and 2/2 twill fabrics were woven by using cotton and polyester yarns with the same yarn count. Then the water repellent chemical was applied to these fabrics. Also lamination was subjected them for the process. As a result of this project, it was revealed that alone water repellent finished fabrics and alone microporous breathable films couldn't provide waterproofness [7].

The purpose of this project is to develop breathable, comfortable, water repellent sportswear garment combined with weft knitted fabric and membrane.

These products' performance will be determined according to the different standards for the rain tests.

## 2. EXPERIMENTAL

### 2.1. Material

In this study, knitting fabric and membrane structure were used for the purpose of improving a comfortable and water repellent hoodie. %55-45 Polyester-Cotton, fleece and raised fabric were used for the main fabric. %100 cotton and single jersey fabric was benefit for membrane structure. Information of the materials is given in Table 2.

**Table 2.** Material Information

Fabric	Knit Type	Composition	Weight (gsm)	Explanation
Main fabric	Fleece (3 Thread)	%55-45 Polyester-Cotton	300	Raised
Membrane laminated fabric	Single Jersey	%100 Cotton	120	-
Membrane	-	Thermoplastic Polyurethane (TPU)	18	Air permeability: -ASTM E96-93BW: 400gsmx24H -JIS L1099-1993 :1400gsmx24H

### 2.2. Method

Water repellent finishing with different two recipes was applied to the main fabric. Parameters of the process are given in Table 3.

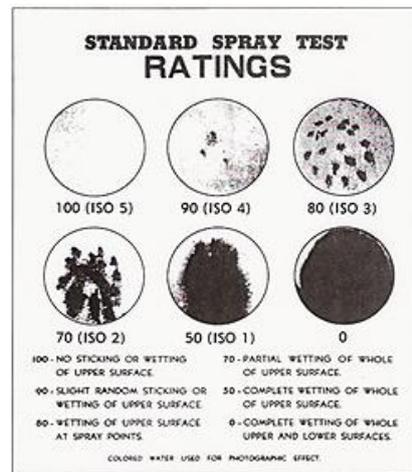
**Table 3.** Parameters of Water Repellent Process

Process parameters		Recipe 1	Recipe 2
Padding bath temperature (°C)		25	25
Clamping pressure (bar)		4	4
Amount of fluorocarbon (g/lt)		30	50
Amount of binder (g/lt)		5	8
Drying process	Transition speed (m/min)	12	12
	Time (sec)	105	105
Curing process	Transition speed (m/min)	18	18
	Time (sec)	65	65

In this project, two different type membranes were produced. In one of them, only one face was covered with 100% cotton single jersey fabric and the other one, two faced was covered with this fabric.

The water repellency tests were applied to all samples. These tests were performed according to AATCC 22:2010 Spray Test, AATCC 35:2000 Rain Test and EN 29865:1996 Bundesmann Rain Test standards.

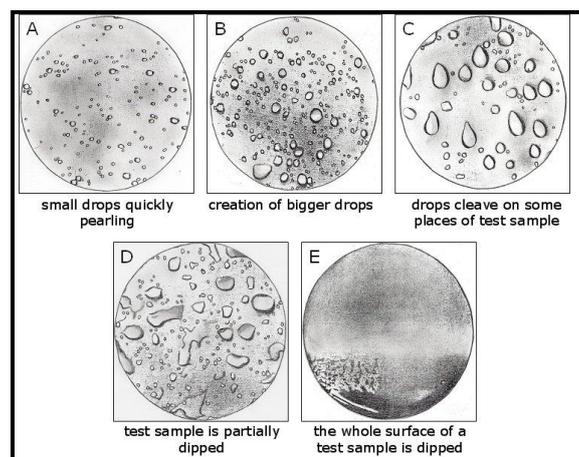
Water sprayed against the taut surface of a test specimen under controlled conditions produces a wetted pattern whose size depends on the repellency of the fabric for AATCC 22 Spray Test. Evaluation is accomplished by comparing the wetted pattern with pictures on a standard chart [8]. This chart is shown in Figure 1.



**Figure 1.** AATCC 22 Rating Scale

A test specimen, backed by a weighed blotter, is sprayed with water for 5 min under controlled conditions for AATCC 35 Water Resistance: Rain Test. The blotter is then reweighed to determine the amount of water which has leaked through the specimen during the test [9].

To determine the resistance to the passage of simulated rain by fabrics being rubbed and rotated for EN 29865 Bundesmann Rain Test. Water which penetrates the fabric is measured and the test specimen weighed to determine the amount of water absorbed [10]. The rating scale of TS EN 29865:1996 standard is shown in Figure 2.



**Figure 2.** TS EN 29865:1996 Rating Scale

### 3. RESULTS AND DISCUSSION

The samples were grouped as in Table 4.

**Table 4.** Obtained Materials

Fabric	Process	Sample Number
Main Fabric	Applied to 1.recipe	1
	Applied to 2.recipe	2
With Membrane - Laminated Fabric	Membrane, one of side laminated,	3
	Membrane, both side of laminated,	4

Test results of the study material are given in Table 5, 6 and 7.

**Table 5.** AATCC 22 Spray Test results

Sample Number	Before Wash	After 10 Washes
1	100	70
2	100	80
3	0	-
4	0	-

**Table 6.** AATCC 35 Rain Test results

Sample Number	Before Wash				After 10 Washes			
	1	2	3	4	1	2	3	4
Weight of blotting paper	5.9	5.25	0.23	0.15	0.01	0.03	-	-

**Table 7.** TS EN 29865:1996 Bundesmann Rain Test results

Sample Number	Before Wash				After 10 Washes			
	1	2	3	4	1	2	3	4
Results								
Water repellent level (after 1 min)	D	D	E	E	E	E	-	-
Water repellent level (after 5 min)	E	E	E	E	E	E	-	-
Absorption of water (showering for 10 min)	%73.6	%75.5	%123.8	%140.1	%68.3	%64.2	-	-
Amount of water (ml)	437.5	252.5	0.6	0	267.5	202.5	-	-

According to the spray test, the results of the sample 1 and sample 2 meet expectations. However, after 10 washes, performance of sample 2 is better than sample 1. This case occurs from the change in the amount of chemicals. According to the rain test result, sample 1 and sample 2 results show similar properties. After 10 washes, the amount of water passing through the fabric decreases because of the felting on the raised side.

The water proofing and water repellency test values of sample 3 and 4 are better than sample 1 and sample 2. These results have been achieved by using of membrane structure. According to the rain test result, sample 3 and sample 4 results are similar.

#### 4. CONCLUSION

In this study, in consideration of the test results, sample 2 and sample 3 were chosen to use combine. The product design is shown in Figure 3. At the final of the project, cost of the product was worked out.



Figure 3. Product design

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